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Find x, y, z and w from the equations

$$x^4+y^4+z^4+x^2+y^2+z^2=112,$$
$$x^4+z^4+w^4+x^2+z^2+w^2=382,$$
$$x^4+y^4+w^4+x^2+y^2+w^2=294,$$
$$y^4+z^4+w^4+y^2+z^2+w^2=364.$$

40. **Proposed by B. F. BURLESON, Oneida Castle, New York.**

Find by quadratics all the possible values for x and y in the equations $x^3+y^3=b=35, \ldots.(1)$, and $x^2+y^2=a=13: \ldots(2)$.

41. **Proposed by A. H. BELL, Hillsboro, Illinois.**

In a right angled triangle there are given, the bisectors of the acute angles. Required the triangle.

◆

GEOMETRY.

Conducted by B. F. FINKEL, Kidder, Mo. All contributions to this department should be sent to him.

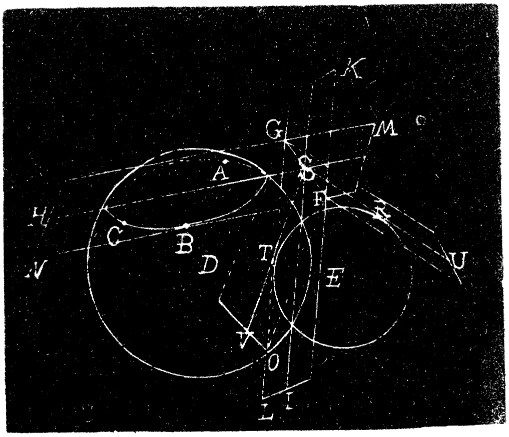
SOLUTIONS TO PROBLEMS.

28. **Proposed by Professor HENRY HEATON, M. S., Atlantic, Iowa.**

Through three given points to pass two spherical surfaces tangent to a given sphere.

Solution by G. B. M. ZERR, A. M., Principal of High School, Staunton, Virginia.

Let A, B, C be the three given points, and E the given sphere.



Through A, B, C describe any sphere cutting the sphere E. Let D be this sphere. Let the planes through A, B, C and the intersection of E, D intersect in the line FG. Through FG pass the planes FH, GO tangent to E at R, T. Then the spherical surfaces through $ABCR$ and $ABCT$ will be the surfaces required.

For draw the diameter of D perpendicular to the plane ABC, then perpendicular to this diameter and through the centre of the circle made by the plane A, B, C, in the plane A, B, C draw the line SH, also through the centre of the circular section made by the intersection of D, E and perpendicular to the line joining their centres in the plane KL draw the line SI intersecting the line SH' at S Draw SR, ST. Then the proof is the same as that for problem 18.

Also solved by Professor H. C. WHITAKER.

29. Proposed by H. W. HOLYCROSS, Superintendent of Schools, Pottersburg, Ohio.

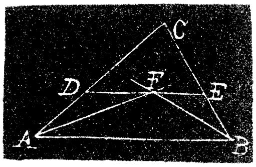
If the two angles at base of a triangle are bisected: and through the point of meeting of the bisectors a line is drawn parallel to the base, the length of the parallel between the sides is equal to the sum of the segments of the sides between the parallel and the base.

Solution by I. L. BEVERAGE, Monterey, Virginia; I. W. TAYLOR, Berea, Ohio; and the PROPOSER.

Let ABC be any triangle, AF and BF the bisectors of the angles A and B, respectively. Through F draw DE parallel to AB. Then $\angle DFA = \angle FAB$, being alternate interior angles of parallel lines. But $\angle DAF = \angle FAB$, AF being the bisector of $\angle DAB$.

$\therefore$ $\angle DAF = \angle DFA$. $\therefore$ The triangle ADF is isosceles and side AD=side DF. In like manner it may be shown that $FE=EB$.

$\therefore$ $DF+FE$, or DE, $=AD+BE$. Q.E.D.



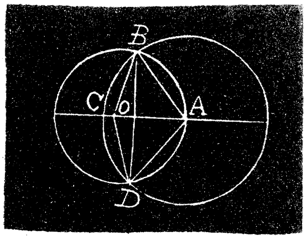
This problem was solved in slightly different ways by *J. W. Watson, G. B. M Zerr, Cooper D. Schmitt, M. A. Gruber, J. K. Ellwood, R H. Young, P. S. Berg, John Faught, J C. Corbin, P. C. Cullen, J. F. W. Scheffer and H. C. Whitaker.*

30. Proposed by CHARLES E. MYERS, Canton, Ohio.

A circle containing one acre is cut by another whose center is on the circumference of the given circle, and the area common to both is one-half acre. Find the radius of the cutting circle.

Solution by J. W. WATSON, Middle Creek, Ohio; W. L. HARVEY, Portland, Maine, J. T. FAIRCHILD, Ada, Ohio; P. S. BERG, Apple Creek, Ohio; and JOHN DOLMAN, Jr., Philidelphia, Pennsylvania

Let O be the center of the circle. A the point on the circumference which is the center of the cutting circle, and R its radius.



With A as a center and radius R draw the arc BCD cutting the circumference at B and D. Join AO and produce it to C. Join CB, OB and AB. Put $r=4\sqrt{\left(\frac{10}{\pi}\right)}=7.136$ rods, radius of the first circle. Put $\angle BAO = \angle OBA = \theta$. Then $\angle BOA = \pi - 2\theta$, $\angle BCA = \angle CBA = \frac{1}{2}(\pi - \theta)$.

$$\text{Sector } BOA = \frac{\pi r^2(\pi-2\theta)}{2\pi}, \text{ sector } BAC = \frac{\pi R^2\theta}{2\pi}, \ \triangle BAO = \tfrac{1}{2}Rr\sin\theta.$$

Then we have $\frac{\pi r^2(\pi-2\theta)}{2\pi} + \frac{\pi R^2\theta}{2\pi} - \frac{1}{2}Rr\sin\theta = \frac{\pi r^2}{4}$.. But $R=2r\cos\theta$.